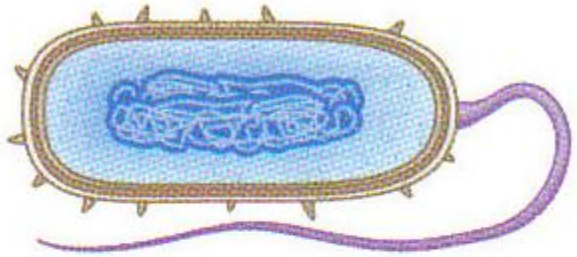
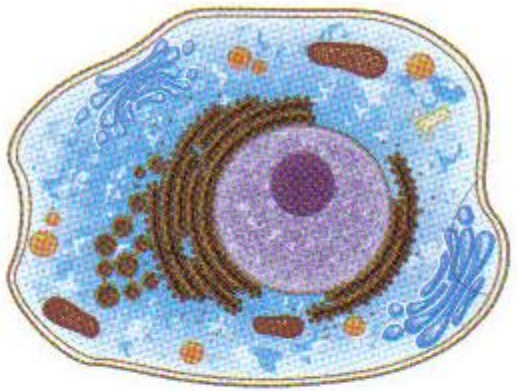
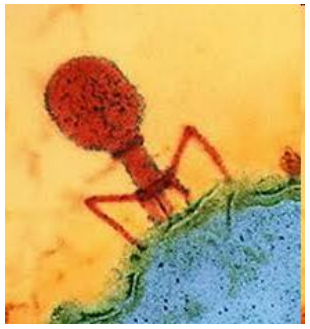
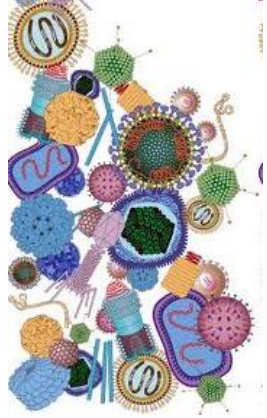

3.3 Viruses

Table 2.1 Two Types of Cells

Characteristic	Prokaryotes: Bacteria, Archaea	Eukaryotes: Protists, Plants, Fungi, Animals
Size	 1–10 μm	 100–1000 μm
Genetic material	• circular DNA, not bound by a membrane • genome made up of a single chromosome	• DNA in nucleus bounded by membrane • genome made up of several chromosomes
Cell division	• not by mitosis and meiosis	• by mitosis and meiosis
Reproduction	• asexual reproduction common	• sexual reproduction common
Number of cells	• unicellular	• most forms are multicellular
Organelles	• mitochondria and other membrane-bound organelles absent	• mitochondria and other membrane-bound organelles present
Metabolism	• many are anaerobic (do not require oxygen to carry out cellular respiration)	• most are aerobic (require oxygen to carry out cellular respiration)

What are Viruses?





- *Virulentus* (poisonous)
- small, infectious, non-living, non-cellular particles
- contain no cytoplasm
- cannot grow or reproduce on their own
- do not produce or use energy
- do not create waste
- packages of genetic instructions that can enter and take control of cells (cell eventually makes copies of virus)
- Antibiotics do not work against viral infection, only antivirals or vaccines

Classifying Viruses

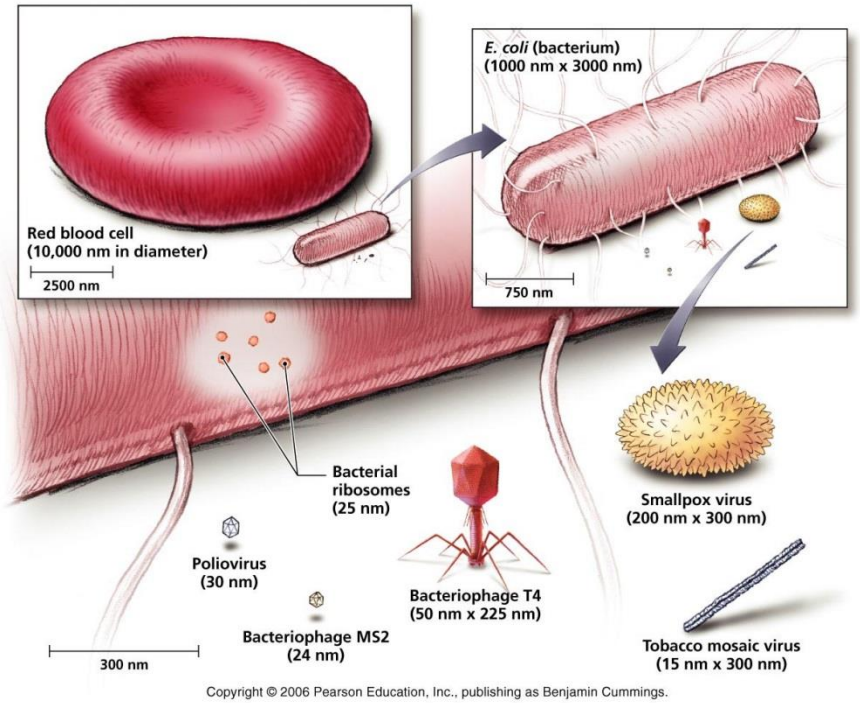
- Since viruses are not cellular, they're not formally considered to be organisms and not part of one of the kingdoms.
- Not included in classification of life but…
- Contain genetic material and reproduce
- Non-living because they require a host to reproduce

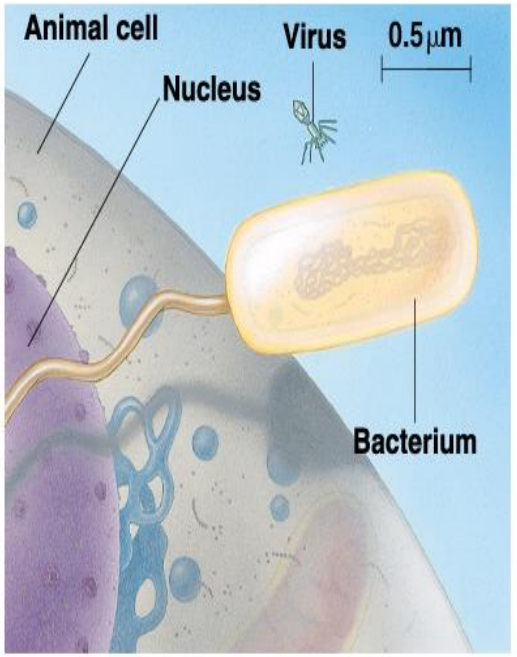
Size of Viruses

- less than 0.1 µm in diameter

- Hundreds of thousands can fit inside a typical human cell.

- Virus size

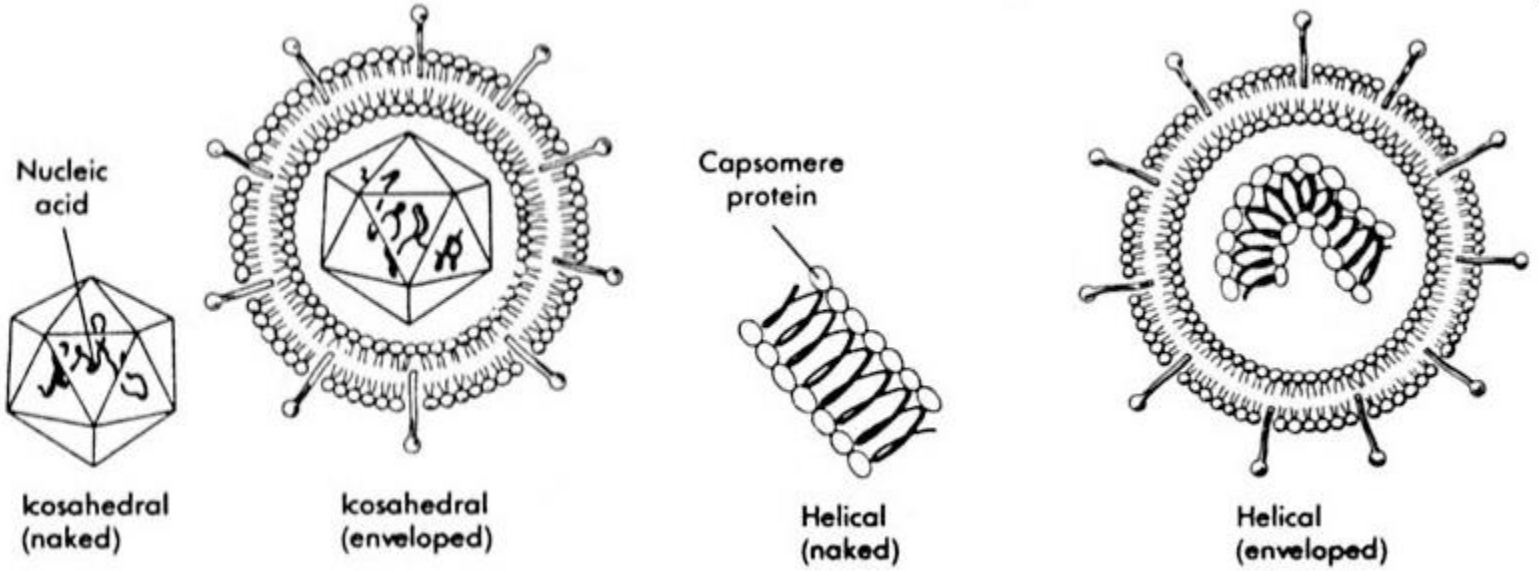




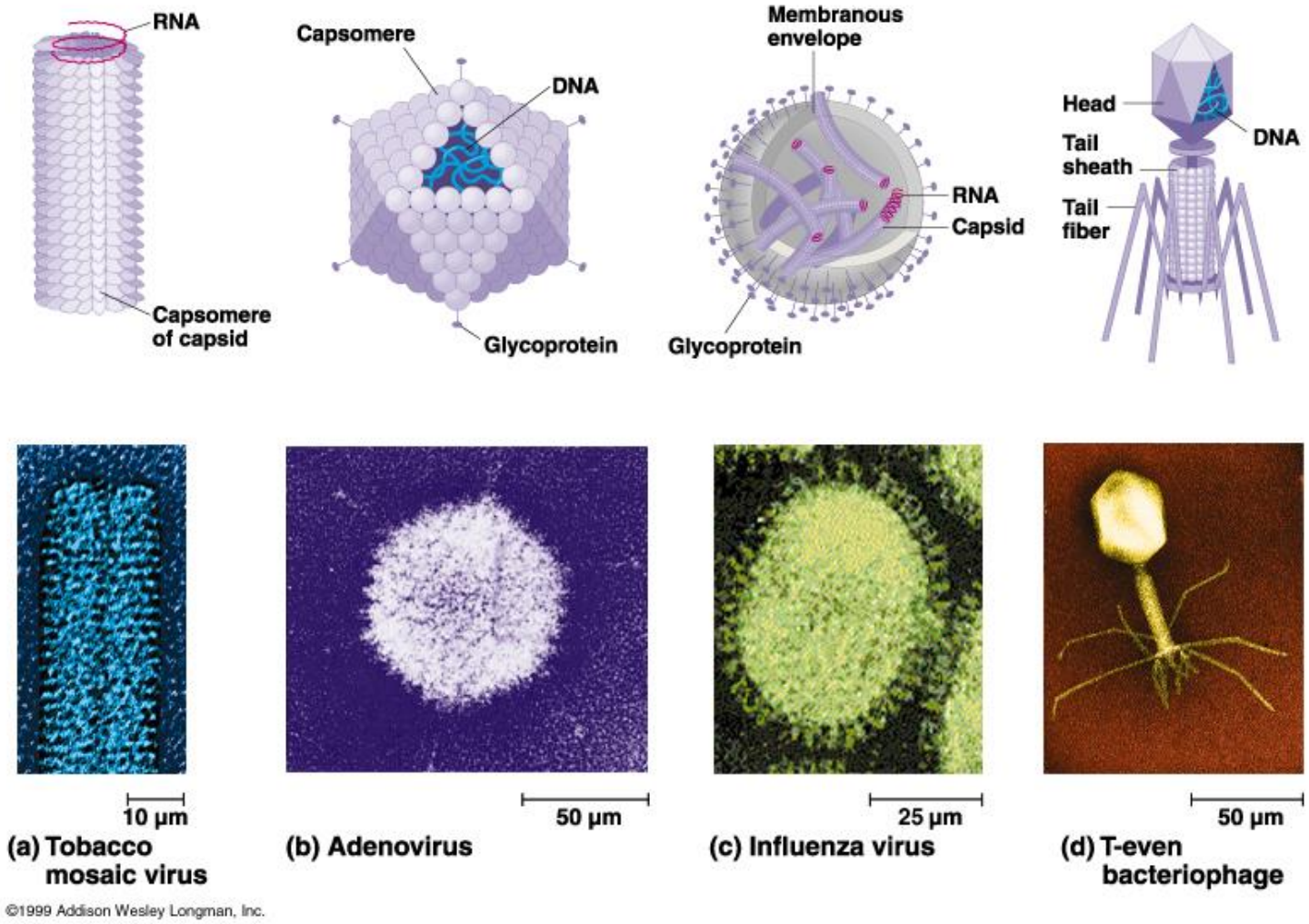
Basic Structure of a Virion (a virus particle)

- ***Genetic material***– RNA (ss) or DNA (ds) core
- ***Capsid (or head)*** – protein coat that surrounds and protects the genetic material

Note: Some viruses are surrounded by an envelope, which is created when a virus leaves a host cell and part of the host cell membrane wraps around the virus.



Diagrams of Viruses



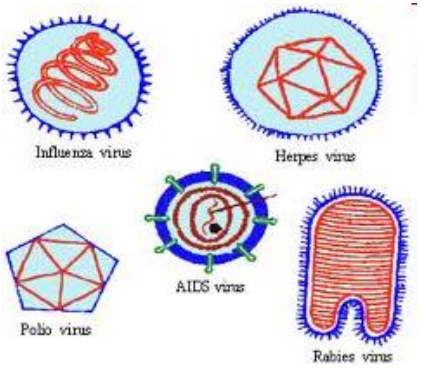
RNA or DNA?

Viruses with RNA (higher mutation rate)

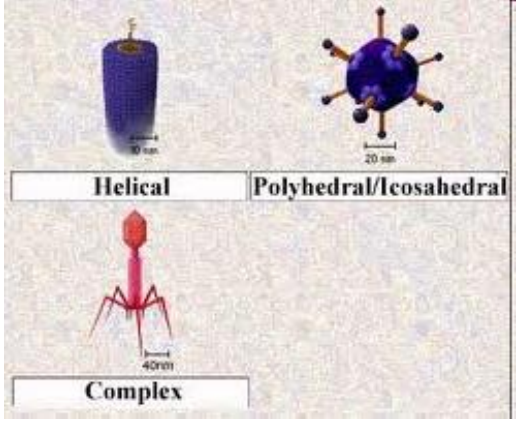
- Human immunodeficiency virus (HIV)
- Influenza viruses
- Rabies
- Measles, mumps, pneunomia, polio, common cold
- SARS

Viruses with DNA (usually stable/constant, vaccines effective)

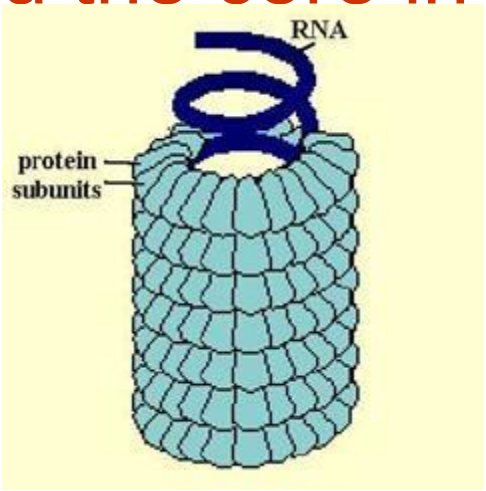
- Chickenpox, cold sores, genital herpes
- Mononucleosis
- Hepatitis
- Respiratory infections, tumours



Virus Shapes



1) **Helical** – rod-like with capsid proteins winding around the core in a spiral



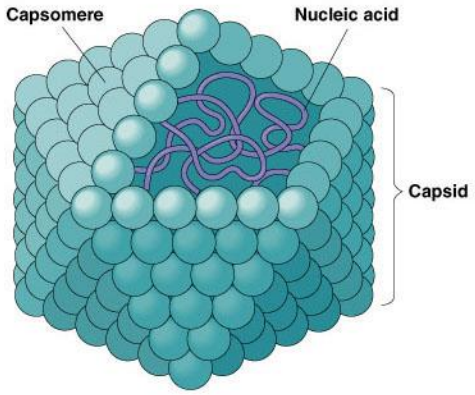
Ex. Tobacco Mosaic Virus

Virus Shapes cont'd:

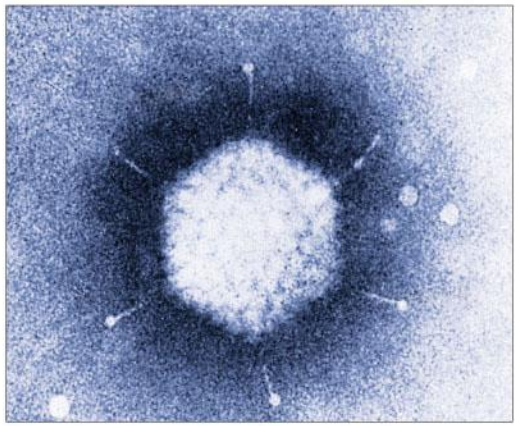
2) **Polyhedral/Icosahedral**

- has many sides

- most polyhedral capsids have 20 sides and 12 corners



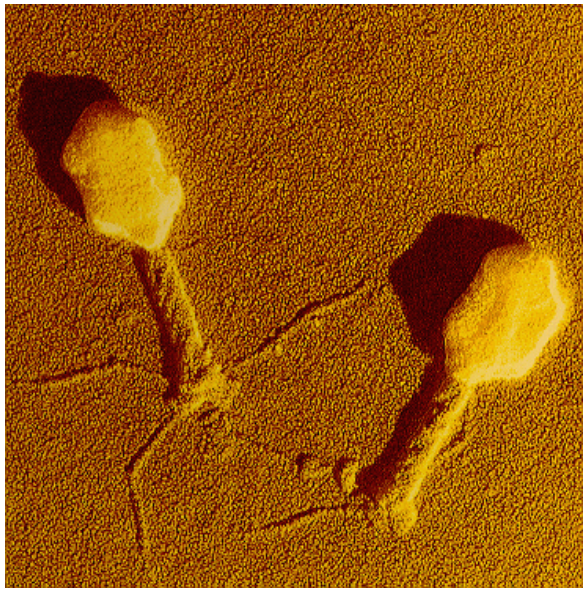
(a) A polyhedral virus

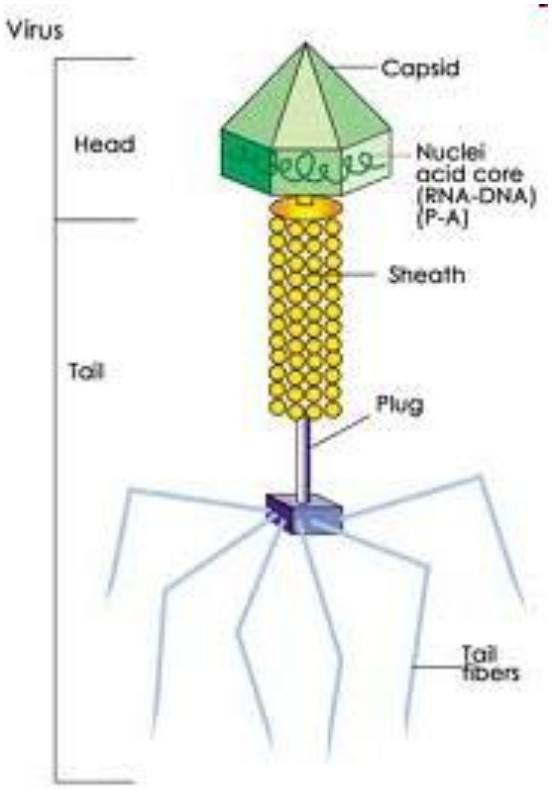


(b) A *Mastadenovirus*

Virus Shapes cont'd:

3) **Complex - Polyhedral capsid *attached* to a helical tail**





- The ***tail*** is made of protein, which aids in binding to host cells.

- This is the typical structure of ***Bacteriophages*** (viruses that attack bacteria). *– Draw and label the bacteriophage above.*

2 methods of Viral replication:

(also called Infectious Cycles)

1) **Lytic Cycle** – the virus enters the cell, replicates itself hundreds of times, and then bursts out of the cell destroying it

1. Attachment

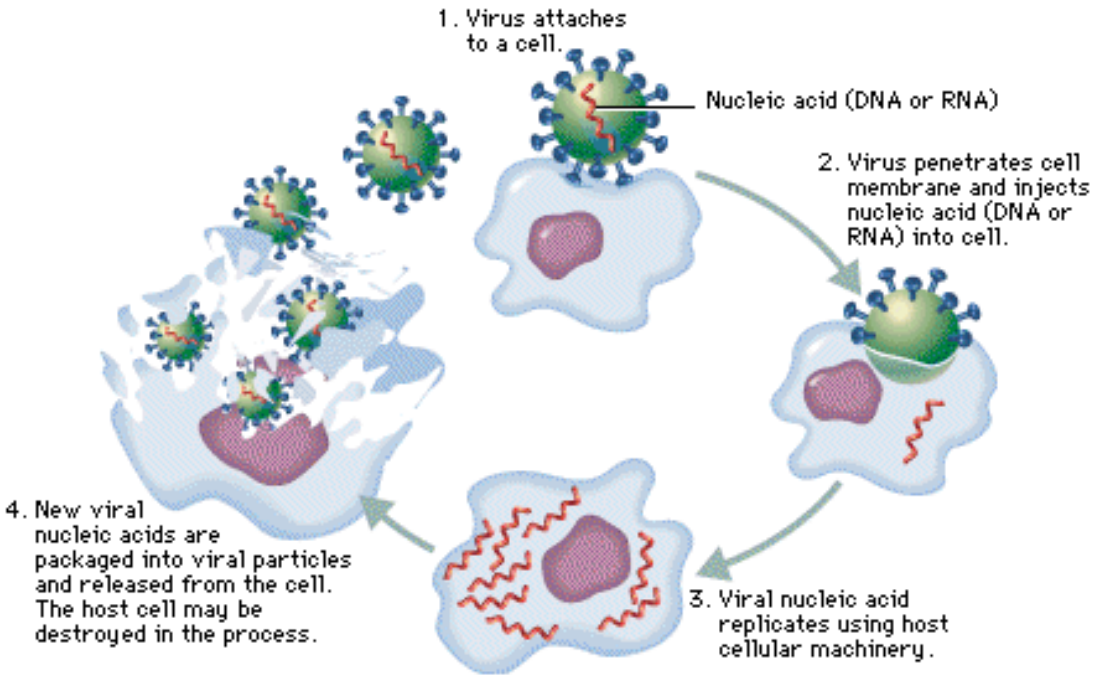
2. Injection/Entry

3. Replication

4. Assembly

5. Release

(lysis = breaking open)



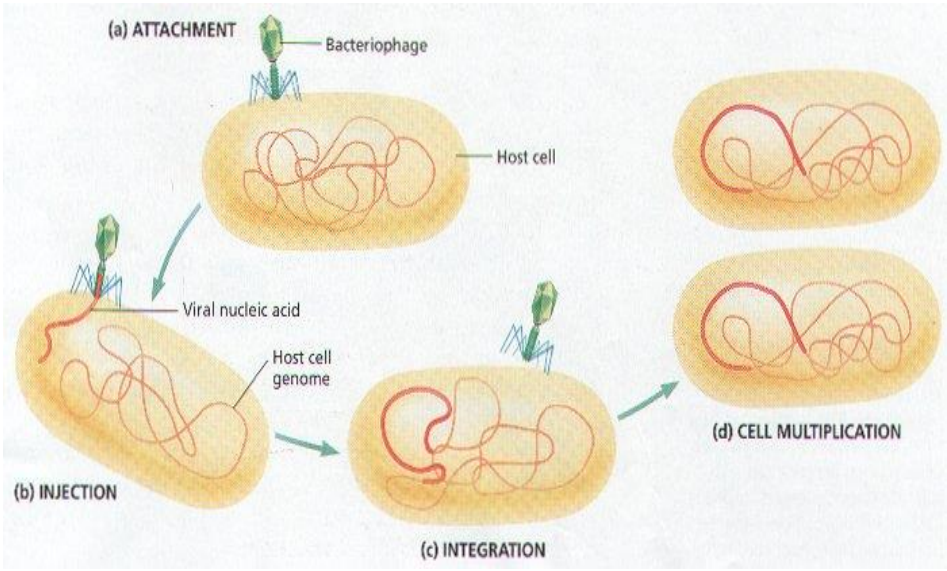
http://www.youtube.com/watch?v=wVkCyU5aeeU&feature=related

2) Lysogenic Cycle

– the virus enters the cell, viral DNA integrates with the host DNA and becomes inactive, the host functions normally

- an environmental change may then cause the virus to enter the Lytic Cycle

1. Attachment
2. Injection/Entry
3. Integration into host cell's DNA
4. Dormancy/Normal cell functions
5. Triggering of viral DNA to be released and then Lytic cycle begins



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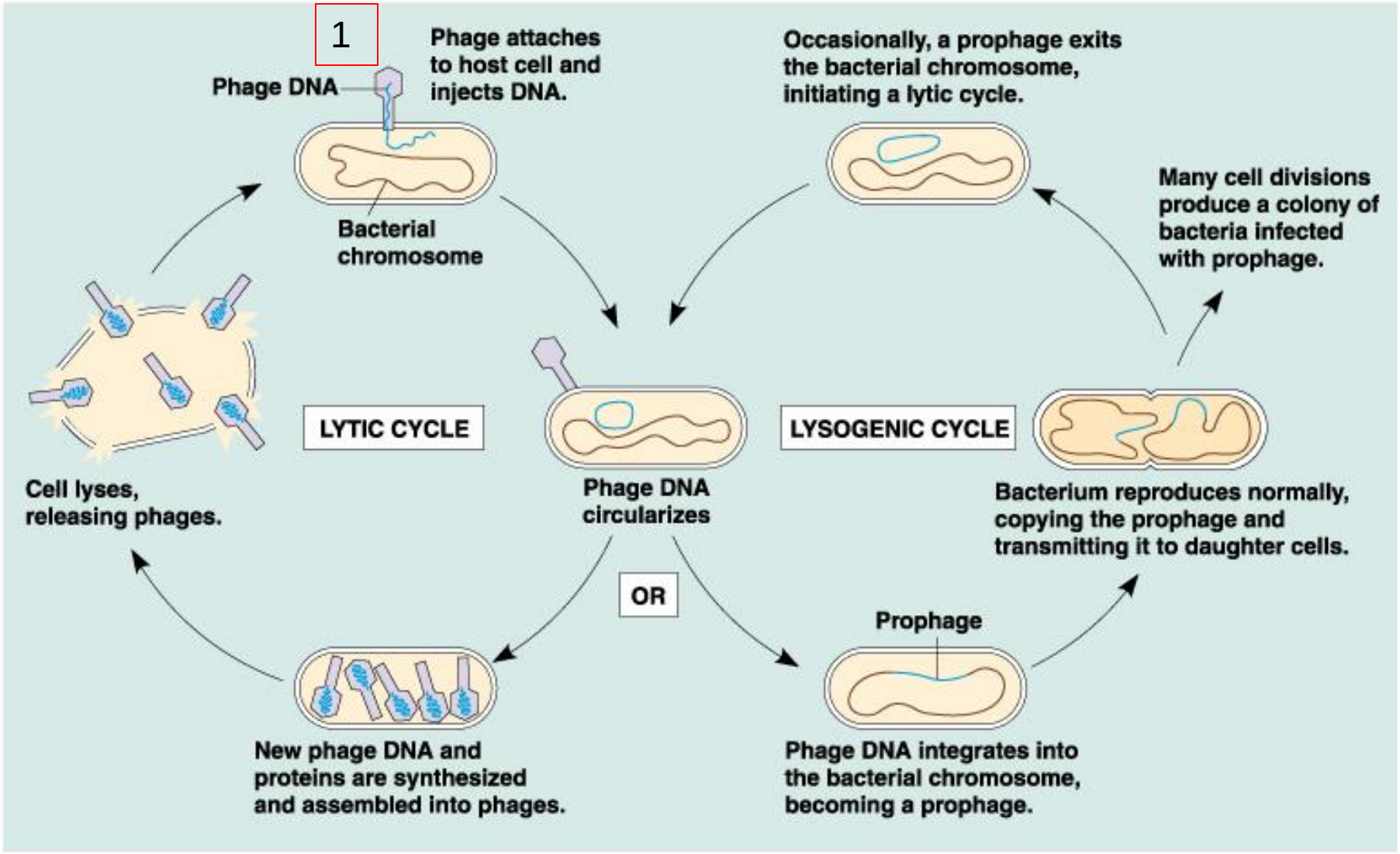
The lambda phage which infects *E. coli* demonstrates the cycles of a temperate phage.



Differences Between Lytic and Lysogenic Cycles

In the Lytic Cycle:

- Viral DNA destroys Cell DNA, takes over cell functions and destroys the cell.
- The virus replicates and produces progeny phages.
- There are symptoms of viral infection.

In the Lysogenic Cycle:

- Viral DNA merges with cell DNA and does not destroy the cell.
- The virus does not produce progeny.
- There are no symptoms of viral infection.

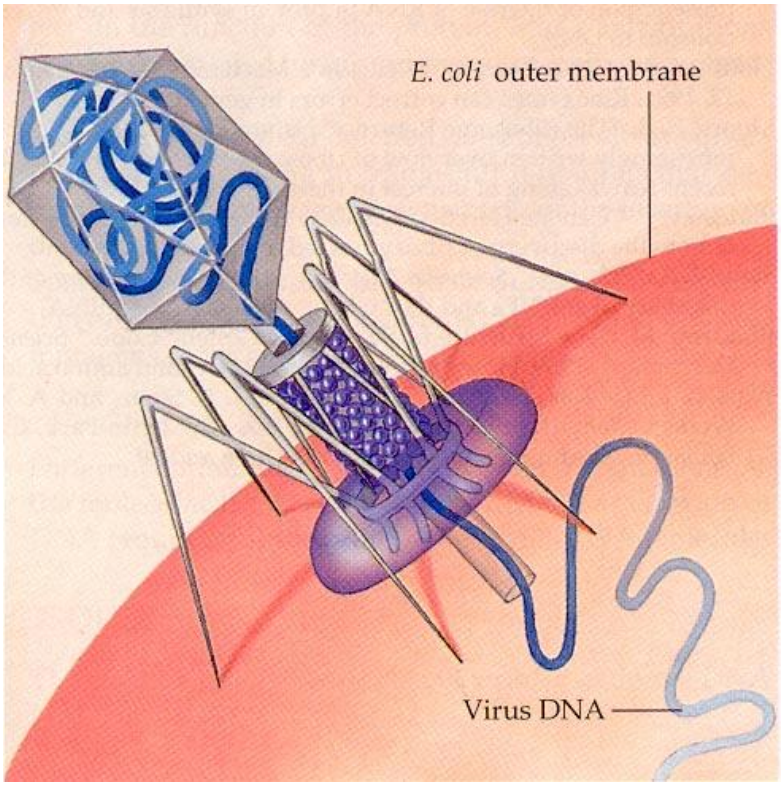
Viruses and Disease

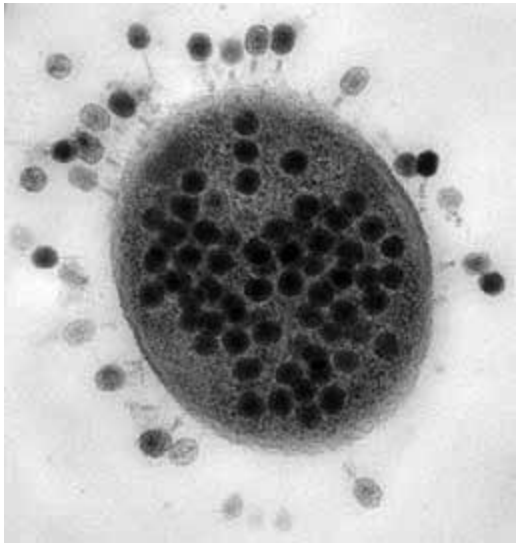
- In viruses that undergo lysogenic cycle, effects on host might not be immediate (HIV)
- HIV is a retrovirus (what is retro?)
- Retroviruses have an enzyme called reverse transcriptase (RNA → DNA)
- Viral DNA enters host chromosome, becoming a provirus
- Certain triggers will cause provirus to become lytic

http://www.youtube.com/watch?v=dn1tNIrMPRk&feature=related

3 ways Viruses enter living cells:

1) enter bacterial cells by punching a hole in the cell wall and injecting its DNA

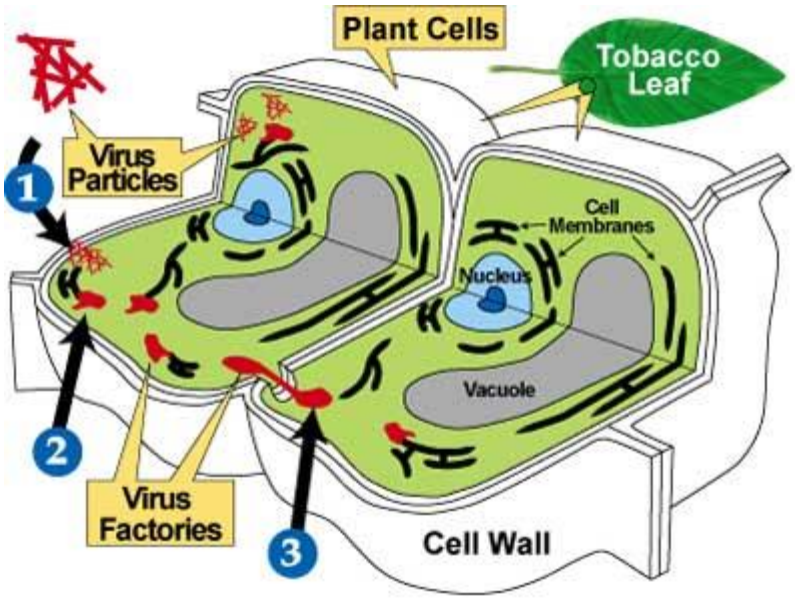


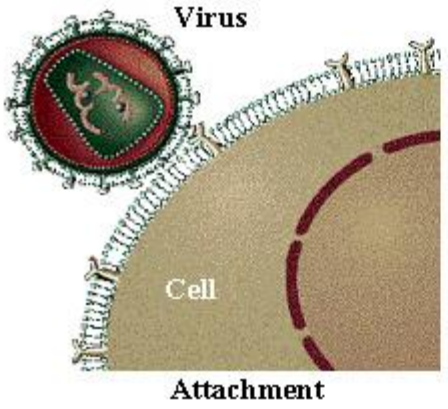


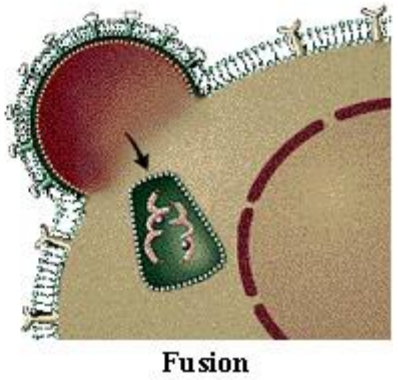
Viruses Enter Living Cells cont'd:

2) enter plant cells through *tiny rips in the cell wall*

3) enter animal cells by *endocytosis*







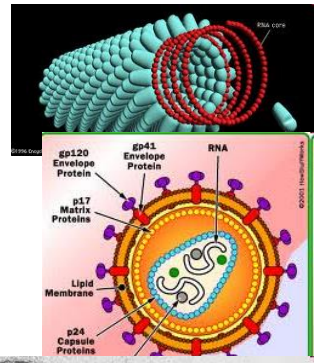
Viruses are host cell specific

- can usually infect one type of host or even an organ, tissue or cell type (called its HOST RANGE)
- a protein on the surface of the virus has a shape that matches a molecule in the plasma membrane of its host, allowing the virus to lock onto the host cell (like a key fits in a lock)

  Examples:

  - a plant virus can only attack a plant cell and not an animal cell

  - HIV (human immunodeficiency virus) infects only certain immune system cells

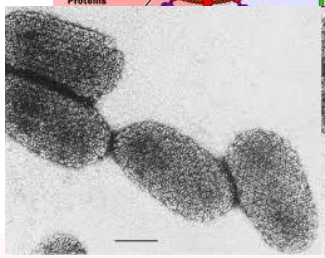


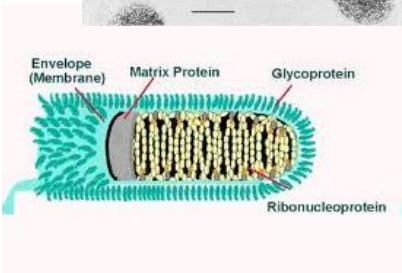
- some viruses can infect many species

  Examples:

  - rabies (rhabdovirus) – infects all birds and mammals

  - swine flu virus can infect swine or humans





How are viruses spread?

- **VECTORS** - carry the virus from one host to another
- Vectors include:

  Insects (yellow fever – mosquitos)

  Animals (rabies)

  Water (polio)

  Air (influenza, common cold, chicken pox)

  Humans (influenza, hepatitis, HIV)

http://www.youtube.com/watch?v=Rpj0emEGShQ

The Origin of the Virus

- The origin of the modern virus is unclear.
- Two hypotheses exist:

1)They could be runaway stretches of nucleic acid from a larger organism that detached and became active, therefore new viruses are forming frequently and many do not have ancestors

2)Viruses once lived outside of host cells, but over time due to their parasitic lifestyle, they lost the genes necessary to live outside the host